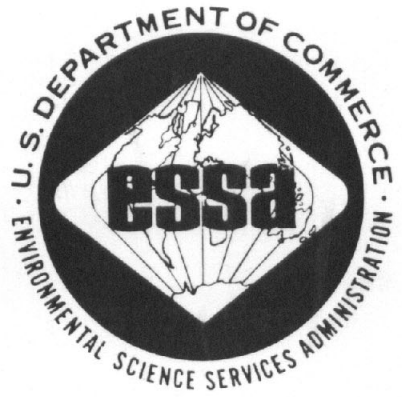
WEATHER BUREAU
Alaska Region

Anchorage, Alaska

December 1968

CLIMATE ALONG A PIPELINE FROM THE ARCTIC TO THE GULF OF ALASKA

Harold W. Searby
Regional Climatologist



Technical Memorandum WBTM AR-2
U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

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Alaska Region Technical Memoranda:

No. 1 Freeze-Thaw Cycle in the Coastal Arctic of Alaska

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FROM THE ARCTIC TO THE GULF OF ALASKA

Harold W. Searby, Regional Climatologist
Anchorage, Alaska

INTRODUCTION

Because of its history and geographical location there has always been great interest in the climate of Alaska. However, up to the mid 1950's, because of the sparcity of data along with the fact that specialized needs to that time did not warrant the publication of reports tailored to a particular development, only routine data type publications were issued.

The year 1956 marked the beginning of a new era in climatological publications for Alaska. The development of farming in the Matanuska Valley produced the need for a special climatic study of the area. The publication of Technical Paper No. 27, titled "The Climate of the Matanuska Valley" in 1956 met this need. Other publications on Alaska climate followed but were issued as part of a program established by Congress, and not because of any particular development or change occurring within the state.

The late 1950's saw the development of better data coverage, providing a better basis for climatic studies. Paralleling this increased knowledge of the state's climatology has been the drastically accelerated rate of industrial development, which now more than justifies the publishing of climatological reports designed to furnish needed information in specialized areas.

The requirement for this and Technical Memorandum No. 1 resulted from the discovery of the new oil field in the Alaska Arctic, which potentially is believed to be one of the world's largest. Technical Memorandum No. 1 discussed climatic

factors in the Arctic. This report concerns itself with the climate along a possible pipeline route from the Arctic to the Gulf of Alaska. This means of transporting crude oil to a point accessible to tankers year round is not the only method proposed but is one being given strong consideration.

If we make the assumption that several producing oil wells have been completed and are ready to start pumping crude oil, a new problem arises. How does the oil get to market? Numerous methods have been proposed by as many different people. A widely discussed method is the construction of a pipeline southward from the producing field. Again we find that the climate is a major factor to be considered.

A pipeline above ground would have to be heated to keep the crude oil from congealing in winter. If the snow could be depended upon to keep the pipe covered, the temperature of the pipe would remain above the critical temperature. Relatively strong surface winds continually keep the snow moving from place to place, so the pipe will never stay covered. To bury it would keep the temperature well above the critical mark, but now a new problem is encountered. There are cracks in the permanently frozen ground which permit enough shifting of the earth to cause breaks in the line.

A pipeline built southward will first traverse the marshes and muskeg to the foothills of the Brooks Mountain Range, then up the northern slopes of the Range itself. The most logical place to cross the mountains appears to be through Anaktuvuk Pass. From this point the route would be generally toward Bettles. Moving on southward the first major river crossing arises at the Yukon. The crossing would probably be made between Rampart and Stevens Village, with the pipeline then headed in the general direction of Fairbanks. Two

possible routes exist from this point to the Gulf of Alaska. One route would take it southward along the railroad, ending in Cook Inlet, Whittier or Seward. The other would follow the highway to Valdez.

Permafrost, lakes and marshy ground are problems that will exist over most of the route. The permafrost does become discontinuous and variable in thickness south of Bettles, and the lakes and marshes are fewer in number south of the Brooks Range.

A much shorter route to water would be to head for Kotzebue Sound or Norton Sound, but at present neither of these have adequate ports and are not open for year round operation.

Now that a proposed route for the pipeline has been outlined, let us talk about the climatic factors along the route.

CLIMATIC CONDITIONS, ARCTIC COAST TO THE BROOKS MOUNTAINS

Surface winds predominate from the east with an annual average of about 12 mph along the coast and slightly lighter inland. Speeds of 35 to 50 mph are common in association with winter storms. Wind data for Barter Island, Barrow and Umiat are found in Table 1.

Conditions of temperature and wind north of the Brooks Range are undoubtedly the least desirable to be found anywhere in the state. It is not only the coldest area, it is the coldest area to also be accompanied by relatively strong winds. Minimum wintertime temperatures average between a minus 15 and a minus 30 degrees. If we give the average wind a range of 10 to 15 mph, and use it together with the temperature, the result is an "equivalent chill temper-

ature" ranging from a minus 40 to a minus 80 degrees. During times of extreme cold the temperature will drop to 40 or 50 below zero. Usually winds are much lighter under conditions of extreme cold. However, a man walking is enough to create a lower equivalent chill temperature and anyone riding in an open vehicle and exposed to the free air is creating the same conditions that results from the wind. In summer daily temperatures usually warm to readings in the 40's and occasionally the 50's. Inland near the foothills temperatures in the upper 50's and 60's are common in summer. Extremes of 85 and a minus 63 have been recorded at Umiat.

Precipitation for the year amounts to 4 to 6 inches which includes the 30 to 50 inches of snowfall in winter. Drifting snow is common because of strong winds and dryness of the snow.

CLIMATIC CONDITIONS, BROOKS MOUNTAIN RANGE

The village of Anaktuvuk Pass is located on the south side of the pass, near the highest point. The Weather Bureau established a climatological weather station there in July of 1953. The sudden interest in a pipeline gives the data new importance.

A contractor working in this area can expect an average annual snowfall of 63 inches, which makes up a large portion of the annual precipitation figure of 10.65 inches.

Wintertime temperatures have been as cold as minus 56 degrees and will have a daily range from a minus 8 to a minus 25 degrees. In summer the daily range is from near 40 to the low 60's, and will occasionally go into the 70's. The highest on record is 91 degrees.

CLIMATIC CONDITIONS, BROOKS RANGE TO FAIRBANKS

Continuing on to the Fairbanks area, although temperature extremes are greater than for Anaktuvuk Pass, the climate is slightly milder. There are fewer occasions of strong winds and the maximum speeds are less. Some drifting of snow occurs, but not nearly as much as over the Arctic slope. Wind data for Bettles and Fairbanks are found in Table 1.

Warmest temperatures in summer are mostly in the upper 60's and the 70's. Extremes go into the 90's. The range of average wintertime lows is from about a minus 5 to minus 25 with extremes in the minus 40's and 50's. The all time recorded low is minus 76 at Tanana.

Annual precipitation amounts are 10 to 13 inches. Summer months receive the heaviest amounts because of thunderstorm activity. Winter snow amounts to 50 to 70 inches.

A problem along this route resulting from climatic conditions are the spring floods caused by ice jams on the various streams. For example the Yukon river usually has several spring ice jams along its hundreds of miles of length with some of them resulting in floods, which could cause trouble for a pipeline.

TWO POSSIBLE ROUTES FROM FAIRBANKS SOUTHWARD

The two possibilities, along the railroad, or along the highway were mentioned earlier. The following is a discussion of the climate along both routes.

CLIMATIC CONDITIONS, FAIRBANKS TO ALASKA RANGE
RAILROAD ROUTE

The portion from Fairbanks to the foothills of the Alaska Range experiences about the same climate as the portion from the Brooks Range to Fairbanks.

Spring ice jams causing floods are also of importance here. Three rivers, the Chena, Tanana and Nenana combine to aggravate the problem. The seriousness of the flooding is in part determined by the amount of snow that occurred in the watersheds of these rivers during the winter.

Wind data for Nenana and Summit are found in Table 1.

CLIMATE CONDITIONS, ALASKA MOUNTAIN RANGE

Strong surface winds in the mountains are usually localized and are found in passes and near the mouths of valleys. The weather reporting station at Summit, which is in a location where strong winds frequently occur in winter, verifies this many times each winter season. The reports of strong winds are always accompanied by reduced visibility in blowing snow which causes drifts. A summary of Summit winds is found in Table 1.

Temperatures here are not as warm in summer or as cold in winter as are found to be north of the range. Recorded extremes are 89 in summer and minus 54 in winter. Summer maximums are usually in the 60's and winter minimums between zero and minus 10.

Total precipitation varies from 15 to 30 inches each year which includes the water equivalent of the wintertime snowfall of 75 to 150 inches. Numerous thunderstorms each summer make the months of July and August the heaviest for precipitation.

CLIMATIC CONDITIONS, ALASKA RANGE TO COOK INLET

South of the Alaska Range the railroad follows the broad Susitna River Valley. The terrain drops fairly rapidly from 2401 feet at Summit to 717 feet where it

crosses the Susitna river at Gold Creek. The change of elevation is gradual from this point southward to Cook Inlet.

Weather conditions from the southern foothills to the Inlet are variable, but with a uniform enough variation that it can be treated as one area. Again beginning with surface winds, the direction is generally northerly or southerly with a few exceptions where the Matanuska River Valley and Knik Arm winds are northeast to east in winter and southeast to southwest in summer. Average speeds are usually stronger on the Inlet end (5 to 8 mph) and extreme winds occur more frequently in the Cook Inlet area, and in the Matanuska Valley where they are channeled by the river valley and the Knik Arm. Extreme speeds in the valley are generally 25 to 40 mph. Wind data for Anchorage and Talkeetna are found in Table 1.

Extreme temperatures are both warmer and colder just to the south of the Alaska Range than in the Cook Inlet area but year round averages are the reverse. Maximum temperatures in summer are mostly in the upper 60's and low 70's with the extremes in the high 80's and low 90's. In winter low temperatures have a greater variation, ranging from zero to 5 below zero in the north to 5 to 10 above zero at the Inlet end. Extremes range from minus 50 in the north to near 40 below zero over the northern half of Cook Inlet.

Precipitation is related to the elevation. The higher the elevation the greater the amount of precipitation. The variation is from 15 inches annually in the south to near 30 inches in the southern foothills of the mountains. Winter snowfall is about 70 inches in the Cook Inlet area. Amounts increase northward, increasing to approximately 100 inches in the Talkeetna area, and 150

inches in the foothills of the Alaska Range. There will be isolated areas of up to 200 inches. Much of the summer rainfall results from thunderstorms from the Matanuska-Susitna valleys northward.

Cook Inlet is usually free of ice or at least free enough for safe navigation from the Forelands southward, and the large diurnal of the tides manages to keep the ice broken up enough so that from the Forelands northward to the port of Anchorage is also navigable year round. To terminate at either Whittier or Seward would involve no new problems as a result of the climate.

CLIMATE CONDITIONS, FAIRBANKS TO SOUTHERN SLOPES OF CHUGACH MOUNTAINS

This portion of the route along the highway covers a rather long distance, including considerable variation in altitude and terrain. Yet with a few exceptions average values of wind, temperature and precipitation show only small variations from one place to another. The Alaska Range crosses this portion of the highway route roughly at mid point. On either side of the mountains surface winds average 5 to 8 mph annually with monthly variations of 3 to 10 mph with the strongest during spring and summer months. Near and in the mountains there are isolated areas of strong winds, primarily in winter. These areas are through mountain passes and narrow valleys. Drifting of snow in winter in these areas creates a serious problem for the highway department in keeping the roads open during strong wind periods. Isabell Pass is an excellent example of this problem. Trims Camp near the top of the pass reports speeds of 20 to 40 mph in summer and 30 to 55 mph in winter with occasional occurrences to 75 mph. Wind data for Big Delta and Gulkana are found in Table 1.

Daytime temperatures in summer usually range between 60 and 75 degrees dropping into the low 50's and upper 40's at night. Extreme maximum values are in the 80's and occasionally near 90. Winter daytime temperatures vary between 5 and 15 degrees with a few days in the 20's, dropping to minus 10 to 25 degrees during midwinter. Extreme winter lows will range as low as minus 45 to 60. A prolonged period of cold weather usually occurs each winter. During these times there is little fluctuation of temperature from day to night with readings in the minus 40's or colder. Fortunately wind speeds are quite light during these periods, but as on the Arctic Slope, the equivalent chill temperature is a concern to those exposed to the free air.

Precipitation annually is 10 to 12 inches. As usual this includes the annual snowfall amounts of 35 to 70 inches. This much variation in snowfall amounts might be expected to cause a considerable variation in the water equivalent of the snow as well. There is variation, but since the snow is necessarily "dry snow" because of the cold temperatures at which it usually occurs, the variation is not large enough to be reflected to any great extent in the total annual precipitation amount.

Spring floods caused by ice jams also create problems along this route because of the necessity of crossing numerous streams. It should not be as serious however as for the route along the railroad.

CLIMATIC CONDITIONS, THROUGH THE CHUGACH MOUNTAINS TO VALDEZ

The last leg of this route again passes through mountains, and also through the area that holds the record for total snowfall in Alaska during a winter season (September through April). A total of 974.5 inches of snow was re-

corded for the winter season of 1952-53 by the Cooperative Weather Station in Thompson Pass. In February of 1964 a record monthly amount of 346.1 inches was measured. The average seasonal snowfall is 558.6 inches. Like other passes that have been mentioned, surface winds cause considerable trouble for the highway crews. Snow drifted by winds of 30 to 70 mph occurs several times each month during the snow season. A figure for the total annual precipitation is not available because the observing station operated by the Highway Department is open only during the winter. The water equivalent for just the snow amounts to 61 inches annually.

Because of the proximity of the pass to the warmer air of the Gulf of Alaska, wintertime temperatures are much warmer than the area immediately to the north. During the coldest part of the winter readings are usually between zero and 15 degrees and the coldest temperature recorded at this station is minus 39 degrees, occurring in February of 1964.

Climatic conditions coming down the southern slopes of the Chugach mountains reflects a gradual moderation of temperatures and a decrease in precipitation amounts. At Valdez surface winds although still strong on numerous occasions are not as strong as through Thompson Pass.

Temperatures show considerable change from that in the interior. The extremes range from 87 to a minus 28. Summertime days warm into the 50's and low 60's and in winter the nights during the coldest months have temperatures dropping to between 5 and 25 degrees. Equivalent chill temperatures are still a consideration, but not nearly as important as for the areas where subzero readings are common.

Precipitation is heavy compared to other areas described. Annual snowfall ranges 250 to 400 inches and is usually a wet snow, making a substantial contribution to the total annual precipitation of 60 to 90 inches. Heaviest precipitation amounts occur from August through November.

SUMMARY

Average ground temperatures in degrees Fahrenheit, for the first day of the month for the following stations are given in Tables 2 and 3.

1. Anchorage
2. Bettles
3. Big Delta
4. Fairbanks
5. Gulkana
6. Summit

If a user has need for more detailed ground temperature data for the sites presented here, write to the following address:

Regional Climatologist
Weather Bureau Alaska Region
632 Sixth Avenue
Anchorage, Alaska 99501

Questions related to any of the information presented in this publication should also be directed to the above address.

Most of the statistical information spread throughout the narrative section is also presented in condensed form as a part of Figure 1, a map of Alaska and the pipeline route.

With today's technology it is not likely that any of the climatic conditions described here will prevent the construction of a pipeline. However, it is possible that costs of construction and operation can be estimated more real-

istically, and thereby contribute to the eventual determination of the most feasible means of transporting crude oil from the Arctic to market, whether by pipeline or some other method.

REFERENCES

1. Robert F. Dale, "The Climate of the Matanuska Valley", Technical Paper No. 27, U. S. Department of Commerce, Weather Bureau.

2. G. W. Aitken, "Ground Temperature Observations, Big Delta", Technical Report 104, May 1964. U. S. Army Materiel Command, Cold Regions Research and Engineering Laboratory (USA CRREL).

3. G. W. Aitken, "Ground Temperature Observations, ~~Big Delta~~ Gulkana", Technical Report 106, November 1964. U. S. Army Materiel Command, Cold Regions Research and Engineering Laboratory (USA CRREL).

4. Climatography of the United States, Nos. 11-48, 86-43 and 60-49, and Local Climatological Data Summaries (published and unpublished) for stations along proposed pipeline route.

Table 1

SURFACE WIND DATA

Month	January	February	March	April	May	June	July	August	September	October	November	December	
Anchorage	5.6 NNE	6.4 N	7.0 N	7.1 N	8.2 S	7.8 S	6.9 S	6.5 NNE	5.9 NNE	6.2 N	6.0 NNE	5.7 NNE	6.6 N
	44 NE	44 N	35 NNW	35 SE	33 N	33 S	28 SSW	30 SW	33 S	40 NE	34 S	41 NE	
Barrow	11.2 ESE	11.1 E	11.3 ENE	11.6 NE	11.7 ENE	11.4 E	11.6 E	12.6 E	13.2 E	13.6 E	12.7 E	11.4 E	12.0 E
	49 E	45 ESE	58 W	40 WSW	37 E	35 SW	35 SW	36 SW	37 ENE	55 W	54 W	44 E	
Barter Island	13.9 W	14.1 W	13.5 W	12.2 W	12.0 E	11.2 ENE	10.2 ENE	11.5 E	12.7 E	14.5 E	14.9 E	13.8 E	12.9 E
	75 SW	62 W	75 W	52 W	48 W	38 W	40 WSW	44 WSW	78 W	58 W	67 WSW	72 W	
Bettles	5.6 NNW	6.8 NNW	6.4 NNW	6.9 NNW	6.4 NNW	6.1 NNW	6.0 SSE	5.4 SSE	6.0 NNW	5.7 NNW	5.4 NNW	6.0 NNW	6.1 NNW
	31 NW	24 NW	23 NW	32 NNW	22 NNE	25 WSW	29 SW	20 SW	23 NNE	30 ENE	31 NNE	50 SW	
Big Delta	10.8 ESE	9.9 ESE	8.2 ESE	7.6 W	7.9 SW	6.5 SW	6.0 SW	6.5 S	7.2 ESE	8.4 ESE	9.4 ESE	9.5 ESE	8.2 ESE
	50 S	50 S	61 SSW	44 SSW	45 SW	43 E	38 SSW	46 S	59 S	55 SSW	51 ESE	60 E	
Fairbanks	2.8 N	3.6 N	4.7 N	6.3 N	7.2 N	6.5 SW	6.1 SW	5.7 N	5.8 N	5.3 N	3.9 N	2.8 N	5.0 N
	29 W	33 W	36 WSW	31 SW	31 WNW	29 ESE	29 E	34 W	26 SW	40 WSW	30 W	32 SW	
Gulkana	5.2 N	5.5 N	5.9 WNW	8.3 SE	8.8 SE	8.9 SE	7.8 SE	7.8 SE	7.7 SE	6.2 SE	4.7 N	2.8 N	6.6 SE
	45 NNE	49 SSE	39 SE	46 NNE	37 SE	35 SE	38 SSE	36 SE	37 SSE	49 SSE	50 N	49 N	
Summit	10.9 NE	8.7 NE	8.3 NE	6.1 NE	6.9 W	7.6 SW	7.0 SW	6.5 SW	6.8 NE	5.8 NE	9.7 NE	11.2 NE	8.0 NE
	49 E	38 ENE	45 E	37 SW	31 SW	46 W	30 WSW	28 WSW	35 WSW	36 E	33 WSW	39 E	
Talkeetna	7.1 N	5.0 N	5.0 N	4.4 N	4.3 S	4.2 S	3.7 S	2.7 S	3.2 N	3.4 NNW	5.0 N	4.6NNW	4.4 N
	38 NNW	31 SSE	24 N	24 N	23 N	22 S	25 S	20 S	24 NNE	38 N	31 N	31 NNE	
Umiat	9.1 W	7.8 W	6.1 W	7.8 W	8.7 E	9.7 E	7.0 E	6.8 E	7.7 E	5.2 WSW	8.7 W	7.6 W	7.7 W
	N O N E												
Nenana	6.7 ENE	5.2 E	5.7 NW	6.1 NW	5.6 WSW	4.7 SW	3.6 SW	4.2 W	5.2 E	6.0 ENE	5.7 E	4.8 E	5.3 E
	38 ENE	37 WSW	39 ENE	31 ENE	30 S	46 SE	24 S	31 NW	36 SE	38 E	37 E	39 WSW	

Note: Top line for each station represents average velocity and prevailing direction.
Bottom line is speed and direction of extreme winds.

Table 2

AVERAGE GROUND TEMPERATURE °F.
For First Day of Month

Depth in Feet	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.0					ANCHORAGE (1948 - 1953)							
0.0	25.8	23.5	24.4	30.3	56.6	61.6	62.8	64.1	55.2	44.0	31.2	21.3
0.5	28.9	27.0	26.7	30.7	35.3	44.0	53.3	57.9	53.1	44.9	33.9	29.4
1.0	30.0	28.3	28.0	30.7	34.5	43.3	53.3	56.8	53.2	45.9	35.2	31.2
2.0	31.7	31.0	29.5	30.4	32.1	35.3	48.8	53.1	51.1	46.4	35.1	32.7
4.0	35.1	34.8	32.7	32.6	33.3	33.9	45.2	51.6	52.5	52.6	41.4	37.2
7.0	37.5	36.3	34.8	34.0	34.0	34.2	40.6	47.2	48.4	48.8	43.6	40.1
11.0	38.5	37.6	34.9	34.9	34.6	34.7	38.2	41.9	46.0	47.2	44.9	41.0
16.0	40.9	39.9	39.4	38.0	36.9	36.4	35.4	38.2	39.9	42.3	38.1	42.6
22.0	41.7	40.6	39.9	38.8	40.4	40.1	40.1	38.6	39.7	42.3	41.9	44.0
					BETTLES (1952 - 1959)							
0.0	-4.0	-4.5	-4.2	-3.3	-0.2	7.7	12.1	13.0	7.2	0.5	-1.3	-2.6
0.5	-1.5	-2.9	-1.5	-3.3	-0.2	3.6	9.7	10.7	7.9	2.1	-0.6	-0.6
1.0	-1.6	-2.2	-2.4	-2.3	-1.2	1.9	7.5	11.4	8.2	2.0	0.4	-0.9
2.0	-0.5	-1.0	-1.6	-1.6	-1.0	0.3	7.9	10.1	8.2	3.3	1.0	-0.2
4.0	0.3	0.2	-0.3	-0.6	-0.4	0.2	5.1	8.1	7.9	4.4	1.8	0.8
7.0	0.4	0.4	0.2	-0.3	-0.3	0.5	2.1	5.2	6.4	3.7	2.2	1.1
11.0	0.7	0.6	0.5	0.1	0.1	0.5	0.8	3.3	5.0	3.9	2.4	1.3
16.0	1.0	0.8	0.6	0.3	0.2	0.5	0.5	1.8	3.5	3.3	2.2	1.4
22.0	1.0	0.8	0.6	0.3	0.3	0.6	0.2	0.8	2.0	2.2	1.8	1.3
					BIG DELTA (1947 - 1960)							
0.0	14.2	10.8	14.3	20.4	43.0	60.9	64.6	62.4	52.6	35.4	25.7	20.6
0.5	16.9	11.8	13.9	19.4	32.6	48.2	55.9	56.6	50.2	35.8	29.0	22.1
1.0	19.5	13.5	15.1	19.8	31.4	45.8	54.2	55.6	51.1	37.3	30.8	25.5
2.0	21.7	15.6	16.6	21.0	30.3	40.0	50.5	54.8	50.5	38.6	31.9	27.3
4.0	30.2	24.1	21.3	23.5	27.6	31.2	38.9	47.5	47.9	40.2	34.6	33.0
7.0	33.7	31.4	28.7	27.7	29.2	31.1	31.3	36.4	41.4	39.5	36.5	34.8
11.0	34.5	33.4	32.2	31.0	30.7	30.6	31.5	32.1	37.1	36.2	36.9	35.7
16.0	35.3	34.4	34.0	33.1	32.7	32.5	32.5	32.4	34.3	35.3	36.3	35.8
22.0	35.0	34.6	34.4	33.6	33.3	32.7	32.8	32.6	32.7	33.7	34.4	34.2

Table 3

AVERAGE GROUND TEMPERATURE °F.
For First Day of Month

Depth in Feet	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						FAIRBANKS (1946 - 1950)						
0.1	22.3	25.5	26.6	28.6	37.1	54.9	57.2	57.1	47.5	32.6	27.7	26.4
0.4	24.3	26.6	28.0	29.2	32.4	43.7	48.3	50.5	45.2	34.9	31.1	28.5
2.0	31.6	30.0	31.2	30.7	31.9	31.9	32.4	38.3	42.0	38.0	34.3	32.4
10.0	32.8	32.4	32.5	32.4	32.3	32.1	32.0	32.1	33.2	33.7	34.0	33.3
						GULKANA (1952 - 1958)						
0.0	22.5	19.7	21.4	23.1	36.6	53.8	59.4	56.8	49.6	35.2	26.0	25.0
0.5	24.2	19.3	22.6	24.2	32.0	40.4	48.2	49.7	44.8	37.8	29.7	27.5
1.0	25.4	20.8	23.3	24.7	30.8	37.2	45.2	46.1	44.6	38.2	30.7	28.6
2.0	27.4	24.7	25.5	26.5	29.1	32.7	38.4	41.6	41.3	37.9	32.0	30.2
4.0	31.3	30.8	29.9	29.7	30.0	30.9	31.7	33.3	35.7	35.4	33.1	30.8
7.0	31.8	31.8	31.8	31.3	31.3	31.2	31.4	31.1	32.0	33.4	33.0	31.2
11.0	31.8	32.0	32.0	31.7	31.7	31.8	31.6	31.5	31.7	31.8	32.1	31.4
16.0	31.8	32.0	32.0	31.6	31.7	31.7	31.7	31.4	31.6	31.5	31.7	31.8
22.0	31.8	32.0	32.0	31.7	31.7	31.8	31.8	31.6	31.8	31.7	31.6	31.8
						SUMMIT (1950 - 1959)						
0.0	20.4	21.7	22.8	23.6	32.5	65.8	68.5	68.0	52.0	39.9	30.2	24.6
0.5	22.3	23.6	22.7	25.1	32.0	56.3	61.9	60.7	52.8	34.3	28.4	24.6
1.0	23.3	24.7	22.6	25.8	31.6	52.6	59.4	58.1	50.0	34.1	27.5	24.6
2.0	21.7	24.3	21.6	30.2	32.8	52.3	58.6	50.1	52.0	34.5	28.5	26.7
4.0	30.6	28.9	29.0	29.1	26.3	32.0	42.1	50.4	45.0	36.9	32.3	32.7
7.0	32.7	32.0	31.0	30.9	31.1	30.6	37.3	44.6	44.1	39.4	35.2	33.8
11.0	33.8	33.7	33.0	32.7	31.8	32.5	33.5	38.6	40.4	39.8	37.3	35.8
16.0	35.6	35.4	39.0	33.4	32.5	32.7	33.3	35.2	36.2	38.5	36.6	36.6
22.0	36.0	36.1	35.5	35.2	34.6	33.7	33.6	34.5	34.7	35.1	36.2	36.9

Figure 1

CLIMATE ALONG A PROPOSED PIPELINE IN ALASKA